

Applicant: Victor I. Klimov et al.
Title: OPTICAL AMPLIFIERS AND LASERS
Application No.: 09/805,435
Filing Date: March 14, 2001

Attorney Docket No.: 14952.0297
Examiner: James A. Menefee
Art Unit: 2828
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REMARKS

Claims 1-42, 48, and 57-66 have been cancelled without prejudice. Dependent claims 67-76 have been added. No new matter has been added. No new issues are raised by the amendments. Claims 43-47, 49-56, and 67-76 are pending. Claims 43, 49 and 53 are independent.

Although Applicants disagree with the Examiner's rejection of the cancelled claims, they have been cancelled in the interest of expediting prosecution.

Rejections under 35 U.S.C. § 102(b)

Claims 1-5, 9-12, 14-17, 21-25, 28-32, 37-39, 42-44, 47-50, 53-54, 57, 59-62, and 66 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,537,000 to Alivisatos et al. ("Alivisatos"). Of these, claims 43-44, 47-50, 53-54, and 57 are currently pending. See pages 3-5 of the Office Action.

The Examiner alleges that Alivisatos "discloses a gain medium comprising a concentrated solid 30 including a plurality of semiconductor nanocrystals 32, the nanocrystals being closely packed" (Office Action at page 3). Specifically, the Examiner contends that in claim 43 "the only structural limitations are a gain medium comprising a concentrated solid including a plurality of semiconductor nanocrystals, the nanocrystals being closely packed" (Office Action at page 3). About claim 49, the Examiner states "the claim[] combine[s] the limitations of other independent claims" (Office Action at page 4). With regard to claim 53, "there is further a cavity... arranged relative to the gain medium to provide optical feedback" (Office Action at page 4). Applicants respectfully disagree.

Alivisatos describes an electroluminescent device having a semiconductor nanocrystal electron transport layer (see Alivisatos at Abstract). The electroluminescent device produces light when an applied voltage causes holes and electrons recombine in the electron transport layer. For example, Alivisatos describes the electron transport layer at column 5, lines 64-67: "[e]lectron transport layer 30 is formed using semiconductor nanometer crystals formed from semiconductor materials capable of emitting light when excited by electrons or photons...."

The electron transport layer described by Alivisatos is not an optical gain medium. The Examiner has argued that "[t]he layer produces light in response to a voltage input, and thus may

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be characterized as an active medium, or gain medium.” See the Office Action at page 6. According to the Merriam-Webster Online Dictionary (www.m-w.com), gain is “**3b** : the increase (as of voltage or signal intensity) caused by an amplifier; *especially* : the ratio of output over input.” Optical gain, therefore, is the increase in optical signal intensity caused by an amplifier, e.g., an optical gain medium. An optical gain medium is a material that can amplify an optical signal. While Applicants agree with the Examiner that Alivisatos’ electroluminescent device produces light in response to a voltage, it does not produce optical gain. Alivisatos does not describe any optical input, and therefore does not describe optical gain.

Alivisatos’ electroluminescent device is not a laser. It possesses none of the characteristic features of a laser: the light emitting material does not achieve a population inversion. There is no optically resonant cavity. The device does not produce stimulated emission of light. The device does not emit monochromatic, coherent light.

Independent claim 43

Applicants have discovered a **laser** including an optical gain medium that includes a concentrated solid including a plurality of semiconductor nanocrystals, and a **cavity arranged relative to the optical gain media to provide feedback**. The semiconductor nanocrystals are close-packed, and the concentrated solid provides gain to an optical signal at an energy equal to or less than the maximum band gap emission of the nanocrystals. See independent claim 43.

The Examiner states with regard to claim 43, “...the only structural limitations are a gain medium comprising a concentrated solid including a plurality of semiconductor nanocrystal.... If the applicant wishes to distinguish from the prior art using these limitations then some structure that will necessarily perform these functions must be claimed.” The Examiner also cites *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1469, 15 USPQ 2d 1525, 1528 (Fed. Cir 1990), that “apparatus claims cover what a device is, not what a device does.” See the Office Action at pages 3-4.

The Examiner has not addressed how Alivisatos anticipates a **cavity arranged relative to the optical gain media to provide feedback**. Indeed, Alivisatos does not describe a cavity arranged relative to the optical gain media to provide feedback. Nowhere does Alivisatos describe a cavity, or how a cavity can be arranged relative to an optical gain media to provide

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feedback. The layered structure of Alivisatos' device does not include **a cavity arranged relative to the optical gain media to provide feedback**. This structural feature clearly distinguishes Alivisatos. Independent claim 43, and its dependents, are not anticipated by Alivisatos. Applicants respectfully request that the Examiner reconsider and withdraw the rejection under 35 U.S.C. § 102(b) of claim 43 and the claims that depend from it.

Independent claim 49

Applicants have discovered a method of amplifying an optical signal including **directing an optical beam into a gain medium** including a concentrated solid including a plurality of semiconductor nanocrystals. The concentrated solid is substantially free of defects and **provides gain to the optical signal**. See independent claim 49.

In rejecting claim 49, the Examiner stated only that it "combine[s] the limitations of other independent claims." See the Office Action at page 4. The Examiner has not addressed how Alivisatos anticipates **directing an optical beam into a gain medium**.

The device described by Alivisatos emits light in response to a voltage. The operation of Alivisatos' device does not rely on any optical input. Indeed, nowhere does Alivisatos describe **directing an optical beam into a gain medium**. Alivisatos therefore does not anticipate claim 49, nor the claims that depend from it. Applicants respectfully request reconsideration and withdrawal of the rejection of claim 49 and the claims that depend from it under 35 U.S.C. § 102(b).

Independent claim 53

Independent claim 53 is directed to a method of forming a laser that includes **arranging a cavity** relative to an optical gain medium **to provide feedback to the optical gain medium**. The optical gain medium comprises a concentrated solid including a plurality of semiconductor nanocrystals. The plurality of semiconductor nanocrystals are close packed.

As discussed above, Alivisatos does not describe a cavity, or the concept of feedback. Nor does Alivisatos describe **arranging a cavity** relative to an optical gain medium to provide feedback to the optical gain medium. Therefore, Alivisatos does not anticipate independent

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claim 53, nor the claims that depend from it. Applicants request that the rejection under 35 U.S.C. § 102(b) of claim 53 and the claims that depend from it be reconsidered and withdrawn.

Obviousness-type double patenting rejections

Claims 1-66 were rejected under the judicially created doctrine of obviousness-type double patenting over either claims 1-31 of U.S. Patent No. 6,322,901 or claims 1-20 of U.S. Patent No. 6,207,229 in view of either Alivisatos or U.S. Patent No. 6,057,561 to Kawasaki et al. ("Kawasaki"). Specifically, the Examiner contends that

'901 and '229 are claiming a single nanocrystal, while the present invention is claiming a group of these same nanocrystals that are grouped together, forming a gain medium for use in a laser system. The nanocrystals claimed in '90[1] and '229 exhibit photoluminescence. Both Alivisatos and Kawasaki teach that it is well known that nanocrystals exhibiting photoluminescence are often grouped together into a gain medium and formed into a laser. It would have been obvious to one skilled in the art to make a laser gain material out of nanocrystals as they provide improved optical output at a variety of wavelengths, as taught by Alivisatos and Kawasaki.

See the Office Action at pages 2-3. Applicants respectfully disagree.

According to MPEP 804 II.B.1., obviousness-type double patenting rejections should be applied "when the claimed subject matter is **not patentably distinct** from the subject matter claimed in a commonly owned patent" (emphasis in original). Applicants believe that the obviousness-type double patenting rejection is improperly applied to independent claims 43, 49 and 53 (and the claims that depend from them), as **they are indeed patentably distinct** from claims 1-31 of U.S. Patent No. 6,322,901 and from claims 1-20 of U.S. Patent No. 6,207,229. The claims of the '901 and '229 patents are directed to semiconductor nanocrystals and methods for making such materials. The instant claims are not directed merely to "a group of these same nanocrystals that are grouped together" as alleged by the Examiner (Office Action at page 2). The currently pending independent claims are directed to a laser (claim 43), a method of amplifying an optical signal (claim 49), and a method of forming a laser (claim 53).

The laser of claim 43 includes a cavity arranged relative to an optical gain media to provide feedback. The method of claim 49 includes directing an optical beam into a gain medium. The method of claim 53 includes arranging a cavity relative to an optical gain medium.

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These structures and method steps are not found in the claims of the '901 or '229 patents, and the pending claims are therefore **patentably distinct**.

Furthermore, even if the obviousness-type double patenting rejection were appropriate, independent claims 43, 49, and 53 are non-obvious over the combination of either claims 1-31 of U.S. Patent No. 6,322,901 or claims 1-20 of U.S. Patent No. 6,207,229 with either Alivisatos or Kawasaki.

Independent claim 43 is directed to a **laser** including an optical gain medium that includes a concentrated solid including a plurality of semiconductor nanocrystals, and a cavity arranged relative to the optical gain media to provide feedback. Neither Alivisatos nor Kawasaki teaches, suggests or motivates a person skilled in the art to form a laser including such an optical gain medium and a **cavity arranged relative to the optical gain media to provide feedback**.

Independent claim 49 is directed to a method of amplifying an optical signal. The method includes directing an optical beam into a gain medium including a concentrated solid including a plurality of semiconductor nanocrystals. The concentrated solid is substantially free of defects and provides gain to the optical signal. Neither Alivisatos nor Kawasaki teaches, suggests or motivates a person skilled in the art to **direct an optical beam** into a gain medium including a concentrated solid including a plurality of semiconductor nanocrystals.

Independent claim 53 is directed to a method of forming a laser that includes arranging a cavity relative to an optical gain medium to provide feedback to the optical gain medium. The optical gain medium comprises a concentrated solid including a plurality of semiconductor nanocrystals. The plurality of semiconductor nanocrystals are close packed. Neither Alivisatos nor Kawasaki teaches, suggests or motivates a person skilled in the art to **arrange a cavity** relative to an optical gain medium **to provide feedback to the optical gain medium**.

Applicants respectfully request reconsideration and withdrawal of the rejections under the doctrine of obviousness-type double patenting.

Rejections under 35 U.S.C. § 103(a)

Claims 33 and 34, rejected under 35 U.S.C. § 103(a) as being obvious over Alivisatos (Office Action at page 5), have been cancelled.

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CONCLUSION

Applicants ask that all claims be allowed. Please apply any other charges or credits to deposit account 19-4293.

Respectfully submitted,

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